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EDUCATION

- **Indian Institute of Technology Bombay** | Mumbai | India *[Jul'2019 - till date]*
  PhD in Electrical Engineering (supervisor: Prof. Amit Sethi)
  Title of thesis: *Advanced Techniques in Medical Image Registration: Addressing Complexities and Innovations*
- **Indian Institute of Technology Bombay** | Mumbai | India *[Jul'2017 - Jun'2019]*
  MTech in Biomedical Engineering (supervisor: Prof. Debjani Paul)
  Title of thesis: *Single Test Image-based Automated Machine Learning System for Distinguishing between Trait and Diseased Blood Samples*
- **Damascus University** | Damascus | Syria *[Sep'2010 - Jun'2015]*
  BTech in Biomedical Engineering

RESEARCH INTERESTS

- Computer Vision, Deep Learning, Graph Neural Networks, Histopathology, Image-guided Surgery, Image Registration, Image Matching, Image Segmentation, Image Super-resolution, Keypoint Detection, Machine Learning, Medical Image Analysis, Radiology, Weakly-supervised/Semi-supervised/Unsupervised learning

WORK EXPERIENCE

- **The Aesthetic Evaluation of Breast Cancer Conservative Treatment** *[Apr'23 - till date]*
  PhD Supervisor: Prof. Amit Sethi | Ph.D. Thesis | IIT-B | Collaboration with Tata Memorial Hospital
  - **Objective** To assess the cosmetic outcome of breast-conserving surgery and related treatments using DL
  - Utilizing a transformer-based keypoint detector to detect keypoints on both breasts
  - Constructing graphs based on the set of keypoints obtained from the left and right breasts
  - Measuring the similarities between the graphs using a graph neural network **GNN**
  - Applying a deep learning-based classifier to assign a score based on the measured similarities
- **Keypoint Detection and Image Matching for Retinal Images** *[Dec'22 - Jul'23]*
  PhD Supervisor: Prof. Amit Sethi | Ph.D. Thesis | IIT-B
  - **Objective** Designing a Graph Neural Network-Based Approach for Retinal Image Matching
  - Developed a **semi-supervised** keypoint detection algorithm which demonstrated superior performance compared to the state-of-the-art methods
  - Developed multi-scale Graph Neural Network (GNN) for precise keypoint matching
- **Leveraging Segmentation to Improve Medical Image Registration** *[Jan'22 - May'23]*
  PhD Supervisor: Prof. Amit Sethi | Ph.D. Thesis | IIT-B
  - **Objective** Employing segmentation to guide the registration process
  - Proposed **weakly supervised** semantic attentive medical image registration network
  - Conducted comprehensive experiments on registration tasks including inter-subject, intra-subject, and pre-operative to postoperative registration
  - Established the superiority of our proposed method through rigorous evaluation on diverse datasets including OASIS, Learn2Reg, and BraTSReg
- **Transforming Breast Cancer Diagnosis: Towards Real-Time Ultrasound to Mamogram Conversion for Cost-Effective Diagnosis** *[Dec'20 - May'23]*
  PhD Supervisor: Prof. Amit Sethi | Funding Source: Qualcomm | IIT-B | Collaboration with King's College London
  - **Objective** Our developed method enables real-time conversion of ultrasound images into CT-like images, providing improved diagnostic capabilities in scenarios where CT scanning is not feasible
  - Created a novel simulation pipeline to generate ultrasound images from CT scans.
  - Developed a **domain adaptation** method to enhance the realism of the simulated images
  - Utilized a GAN framework to reconstruct CT images from the simulated ultrasound images
  - Evaluated the quality of the generated images using a pretrained classifier and feedback from radiologists
- **Deep Learning Methods for Mitosis Domain Generalization** *[Apr'21 - Aug'22]*
  PhD Supervisor: Prof. Amit Sethi | MICCAI Challenge 2021
  - **Objective** Addressing the **domain-shift** problem of mitotic figures detection in **histological** tumor images
  - Proposed a **preprocessing homogenizer** in Github-v1 and its improved version in Github-v2
  - Developed **auto-encoder** for image reconstruction and a **domain classifier** for domain recognition.

- Proposed perceptual loss to preserve the semantic information
- Our proposed method won **the best student paper award** in Bioimaging 2023 conference

- **Medical Image Registration for Ultrasound-MRI Fusion in Prostate Diagnostics and Surgery** *[Jun'21 - Jun'22]*
  PhD Supervisor: Prof. Amit Sethi | Source of Funding: Qualcomm | Ph.D. Thesis | IIT-B
  - Registered the 3D preoperative MRI scan to the 3D preoperative Ultrasound scan to form the 3D model of the prostate before the biopsy
  - Proposed a novel architecture called weakly supervised semantic attentive medical image registration network **WSSAMNET** whose performance is comparable to the performance of the state-of-the-art methods for medical image registration such as **LapIRN**
  - Proved that using **Pix2pix GAN** as a conditional segmentation network for registration works much better than the state-of-the-art conditional segmentation network for image registration, the improvement in dice score is around **40%** on the testing dataset
- **Frame-to-volume Ultrasound Registration** *[Jun'21 - Jun'22]*
  PhD Supervisor: Prof. Amit Sethi | Source of Funding: Qualcomm | Ph.D. Thesis | IIT-B
  - **Objective** Getting the annotation of the Ultrasound frame in real-time
  - Developed a deep convolutional neural network for aligning 2D Transrectal ultrasound **TRUS** frame with 3D TRUS volume during the surgery without Hardware Tracking Github
- **Weakly Supervised Semantic Attentive Brain Tumor Sequence Registration** *[Dec'21 - Mar'22]*
  PhD Supervisor: Prof. Amit Sethi | ISBI Challenge 2022 | IIT-B
  - Proposed weakly supervised semantic attentive medical image registration network **WSSAMNET**Github to estimate correspondences between preoperative and follow up MRI scans of the same patient. The robustness of our proposed method is **6%** higher than **VoxelMorph**

PUBLICATIONS

- **Almahfouz Nasser, S.**, Gupte, N. and Sethi, A., 2023. Reverse Knowledge Distillation: Training a Large Model using a Small One for Retinal Image Matching on Limited Data. arXiv e-prints, pp.arXiv-2307. WACV (under review).
- **Almahfouz Nasser, Sahar**; Meena, Mohit; Sresth, Garweet; Sethi, Amit (2023). Leveraging Segmentation to Improve Medical Image Registration. TechRxiv. Preprint.
- **Sahar A. Nasser**, Kurian NC, Shamsi S, Meena M, Sethi A. WSSAMNet: Weakly Supervised Semantic Attentive Medical Image Registration Network. Accepted at the challenge proceeding of the International Conference on Medical Image Computing and Computer-Assisted Intervention 2022. Paper's link, Presentation's link
- Chandra, T.; **Nasser, S.**; Kurian, N. and Sethi, A. (2023). Improving Mitosis Detection via UNet-Based Adversarial Domain Homogenizer. In Proceedings of the 16th International Joint Conference on Biomedical Engineering Systems and Technologies - Volume 2: BIOIMAGING, ISBN 978-989-758-631-6, ISSN 2184-4305, pages 52-56. DOI: 10.5220/0011629700003414 Paper's link Presentation's Link
- **Nasser, S.** and Sethi, A. (2023). Simulating Ultrasound Images from CT Scans. In Proceedings of the 16th International Joint Conference on Biomedical Engineering Systems and Technologies - Volume 2: BIOIMAGING, ISBN 978-989-758-631-6, ISSN 2184-4305, pages 138-145. DOI: 10.5220/0011780700003414 Link Presentation's Link
- **Nasser, S.**, S. Shamsi, V. Bundele, B. Garg and A. Sethi, "Perceptual cGAN for MRI Super-resolution," 2022 44th Annual International Conference of the IEEE Engineering in Medicine Biology Society (EMBC), 2022, pp. 3035-3038, doi: 10.1109/EMBC48229.2022.9871832.. Paper's link, Presentation's Link
- **Nasser, S.**, Kurian NC, Sethi A. Domain Generalisation for Mitosis Detection Exploting Preprocessing Homogenizers. International Conference on Medical Image Computing and Computer-Assisted Intervention 2021 Sep 27 (pp. 77-80). Springer, Cham. Paper's link
- V. S, **Nasser, S.**, G. Bala, N. C. Kurian and A. Sethi, "Multi-Modal Information Fusion for Classification of Kidney Abnormalities," 2022 IEEE International Symposium on Biomedical Imaging Challenges (ISBIC), 2022, pp. 1-4, doi: 10.1109/ISBIC56247.2022.9854644. Paper's link
- **Nasser, S.**, Debjani Paul, and Suyash P. Awate."Single Test Image-Based Automated Machine Learning System for Distinguishing between Trait and Diseased Blood Samples". 2021. arXiv:2103.16285 [cs.CV]. Paper's link

FELLOWSHIPS, SCHOLARSHIPS, WORK EXPERIENCE, AND PEDAGOGICAL

- **Qualcomm Innovation Fellowship 2021-2022 | Qualcomm** *[Jun'21 - Jun'22]*
  - Won Qualcomm prestigious fellowship for the proposal **MRI-Ultrasound Fusion in Prostate Diagnosis and Surgery**. It was pretty competitive, but our proposal made it through multiple rounds and evaluations. Link
- **Reciever of the Damascus University's Scholarship for doing PhD in India** *[Jul'19 - till date]*

- **Reciever of the ICCR Scholarship for doing MTech in India** *[Jul'17 - Jul'19]*
- **System Administrator:** Medical Imaging, Deep learning and Artificial intelligence Lab (MeDAL), Department of Electrical Engineering, IIT Bombay *[Mar'20 - present]*
- **Served as the ambassador of the IEEEXtreme 16.0 coding competition** Link *[Aug'22 - Oct'22]*
- **Reviewed Papers for National and International Conferences** Link1Link2 *[2022]*
  - The IEEE International Symposium on Biomedical Imaging, the National Conference on Communications and The Asian Conference On Machine Learning for Medical Imaging
- **Organizer and Presenter at Koita Center for Digital Health KCDH Workshop 2022** *[Apr'22]*
- **Teaching Assistant**
  - Instructor: Prof. Amit Sethi | Course: Introduction to machine learning EE 769 *[2022]*
  - Co-Instructor/Co-Organizer at Shala: online summer school on DS and ML: SHALA *[2020]*
  - Digital Signal Processing, Image Processing, Multimedia, Microprocessors, and Programming Languages (C++, MATLAB) | Biomedical Engineering | Damascus University, Syria *[2015-2017]*
- **Supervisor | R&D Projects |Biomedical Engineering | Damascus University** *[2015-2017]*
- **Collaboratory Research**
  - Qualcomm, India
  - TATA Memorial Hospital, Mumbai, India
  - King's College London, the UK
  - Whirlpool, Pune, India

ADDITIONAL PROJECTS

- **Perceptual CGAN for MRI Super-Resolution** *[Jul'20 - Jul'22]*
  PhD Supervisor: Prof. Amit Sethi | Research Project
  - Super-resolution (SR), when applied to low-resolution MR images, can help increase their utility by synthetically generating high-resolution images with little additional time
  - Introduced a **conditional GAN** with **perceptual loss** Github, which surpases the state-of-the-art methods for MRI super-resolution. It improves SSIM and PSNR by **30%** and **11%** respectively compared to bicubic interpolation the winning algorithm of **SuperMUDI Challenge MICCAI 2020**
- **Multi-modal Information Fusion for Classification of Kidney Abnormalities** *[Dec'21 - Mar'22]*
  PhD Supervisor: Prof. Amit Sethi | ISBI Challenge 2022
  - Proposed a multi-modal information fusion model for automatic preoperative prediction of risk class for patients with renal masses identified in CT imaging of the kidneys Github. Our **attention-based** framework won the **fourth place** in the competition. The proposed method analyzes renal tumors by fusing both the clinical and imaging features extracted from the latent space of **nn-UNet** that used for segmenting the input image
- **Deep Wavelet for Medical Image Super-Resolution** | *Prof. Gadre* | *Wavelets* Github *[Jul'21 - Dec'21]*
  - Modified dilated convolutional encoder-decoder network **DCED** by replacing down-sampling layers with discrete wavelet transform blocks. It achieved **2%** improvement in PSNR compared to bicubic interpolation
- **Deep Learning for Natural Image Captioning** | *Prof. Sethi* | *Advanced Machine Learning* Github *[Jul'20 - Dec'20]*
  - Implemented the paper titled "Show, Attend, and Tell". The accuracy is **68.5%** on MSCOCO 2014 dataset Github
- **Droplets Detection** | *Prof. Sethi, Shamsi (**Whirlpool**)* | *Introduction to Machine Learning*Github *[Jan'20 - May'20]*
  - Designed a deep learning model to detect whether the droplets in an image are distortion on the lens or are a part of the scene captured. The test accuracy reached **69.46%** using Weighted Cross Entropy Loss on ResNet-18 backbone, **Label Smoothing** and **Adversarial Learning**
- **Hela Cells' Segmentation Using Deep Learning** | *Prof. Awate* | *Medical Image Computing* Github*[Jan'20 - May'20]*
  - Implemented **U-net** and **Mask R-CNN** for Hela Cells' segmentation. The accuracy of semantic segmentation reached **97%**, and the mean average precision of instance segmentation was **0.5**
- **Generating Bokeh Effects In Natural Images** | *Prof. Merchant* | *Course: Image Processing* *[Jul'19 - Dec'19]*
  - **Objective:** Keeping the object of interest intact (in focus), while blurring the background (making it out of focus). The filtering procedure contains three steps: segmenting the object of interest, computing the distance map, and blurring the background according to the distance map Github
- **Single Test Image-based Automated Machine Learning System for Distinguishing between Trait and Diseased Blood Samples**
  MTech Supervisors: Prof. Debjani Paul, Prof. Suyash P. Awate | MTech Thesis | IIT-B *[Jul'18 - Jun'19]*
  - Proposed a machine learning-based method for fully automated diagnosis of sickle cell disease of poor quality unstained mobile microscopic images that have been captured in the field
  - A **random forest** was used for segmenting image segmentation, followed by an **SVM** classifier. The classification was based on the shape features such as form factor, roundness, and solidity of the segmented cells. Our method accuracy, sensetivity, and specificity are **93%, 67%**, and **96%** respectively

- **Kalman Filter for Real-time Object Tracking** | *Prof. Awate and Prof. Rajwade* | *Image Processing* Github *[Jul'18 - Dec'18]*
  - Designed a real-time tracker of an object using a combination of **mean shift tracker** and **Kalman filter**
  - Demonstrated the robustness and accuracy of the proposed method in detecting an object in a live video

TECHNICAL SKILLS

- **Programming Languages:** C, C++, Python, MATLAB, Assembly
- **Tools:** Office, LaTeX
- **Libraries:** PyTorch, Pytorch Geometric, OpenCV, Matplotlib, TORCHIO, MONAI, Wandb, Openslide, 3D Slicer
- **OS:** Linux, Windows
- **Simulation:** OpenFOAM, Stride, PyUS, Field II, MUST
- **Shell Scripting**
- **Circuit Design and simulation:** Codevision, Proteus, Eagle, Labview
- **Version Control:** Git, Docker, Singularity

Relevant Courses from IIT Bombay:

- **EE 678:** Wavelets
- **EE 610:** Image Processing
- **EE 601:** Statistical Signal Analysis
- **CS 663:** Image Processing
- **CS 736:** Medical Image Computing
- **EE 769:** Introduction to Machine Learning
- **EE 782:** Advanced Machine Learning

LANGUAGES

- **Arabic:** Mother Tongue | Level: Professional
- **English:** Second Language | Level: Professional
- **French:** Third Language | Level: Beginners

HONORS AND AWARDS

- **Best student paper award** Bioimaging 2023 conference
- Certificate for participating in the **IEEE EMBC Summer Camp** certificate
- Certificate for serving as the **ambassador in the IEEEXtreme 16.0** Certificate *[2022]*
- Certificate for participating in the **EMBC'22** conference | the UK Certificate *[2022]*
- **Finalist of the IEEE ISBI Knight Challenge**: Kidney clinical Notes and Imaging to Guide and Help personalize Treatment and biomarkers discovery *[2022]*
- Certificate for winning **Qualcomm innovation fellowship 21-22**Winner's Certificate Finalist's Certificate Fund's Cheque *[2021]*
- Certificate for participating in **OpenFOAM** workshop | IIT-B Certificate *[2021]*
- Certificate of Participation in the 3rd Industrial Day organised by the **Wadhwani** Research Center | IIT-B Certificate *[2019]*
- **Honour Code Certificate** for Technical - Communication for Scientists and Engineers | IIT-B *[2017]*
- Five times winner of the **Certificate of Martyr Bassel Alassad for Study Superiority**1 2 3 4 5 *[2011 - 2015]*

REFERENCES

- Prof. Amit Sethi
  Professor, Dept. of EE, IIT Bombay
  Adjunct faculty, Dept. of Pathology, UIC
  Phone: +91(22)25767483 / 4496
  E-mail: asethi@iitb.ac.in
  Relationship: I worked under Prof Amit's supervision for four years during my PhD at MeDAL Laboratory

- Prof. Debjani Paul
  Professor, Dept. Biosciences and Bioengineering, IIT Bombay
  Professor in-charge, Wadhwani Research Center for Bioengineering, IIT Bombay
  Phone: +91(22)25767798
  E-mail: debjani.paul@iitb.ac.in
  Relationship: I worked under Prof debjani's supervision for two years during my Mtech program at Microfluidics Laboratory

- Prof. Suyash P. Awate
  Professor, Dept. Computer Science and Engineering, IIT Bombay
  Asha and Keshav Bhide Chair
  E-mail: suyash@cse.iitb.ac.in
  Relationship: I worked under Prof suyash's supervision for two years during my Mtech program at IIT Bombay